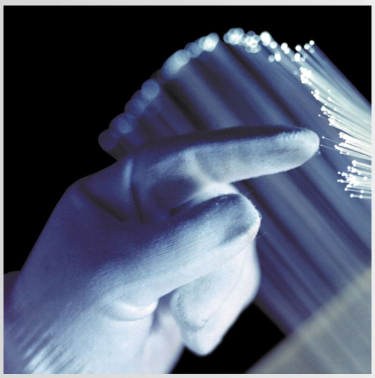
Science.

Technology.

Innovation.

Fiber Optic for Radiation Sensors

Scientists at the Pacific Northwest National Laboratory have developed a one-of-a-kind scintillating optical fiber for sensing both neutrons and gamma rays. The Laboratory's fabrication facility produces rugged, flexible fibers with large light outputs and long transmission lengths. Unlike the alternative technology—gas-filled proportional counters—Pacific Northwest solid-state sensors use scintillating fibers and are less sensitive to vibration. This unique technology allows the scientist or engineer to "think outside the box," creating sensors not previously possible with gas tube technology.

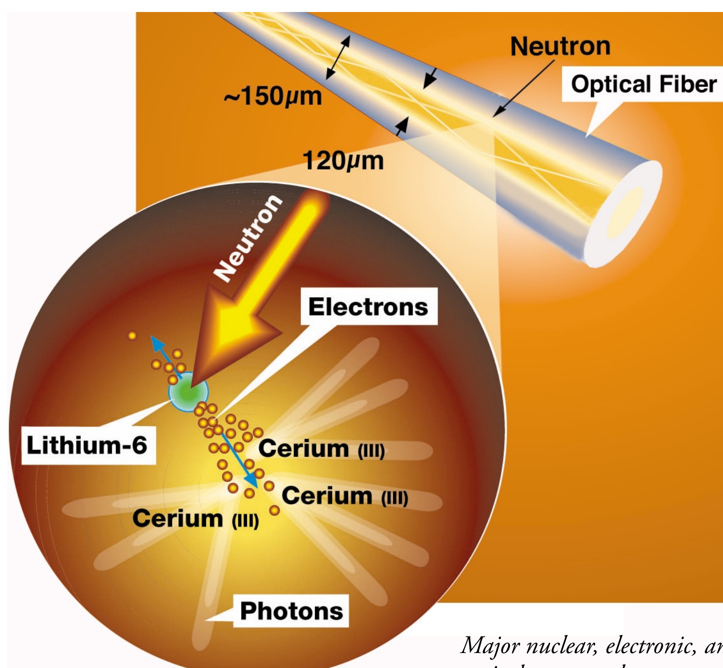


Fiber optic radiation sensors have distinct advantages over the gas tube. They can be larger, thinner and lighter weight with the same sensitivity. Other benefits of the fiber optic sensors:

- ruggedness and flexibility
- versatility in length and numbers
- vibration insensitivity
- lower profile

Fiber sensor technology—the long and short of it

Both the gas tube and the fiber optic sensor can be incorporated into sensors of a multitude of sizes. However, the flexible fiber optic provides greater versatility with potentially less cost. These fibers can vary in length and number, ranging from 1 centimeter to 2 meters long. Pacific Northwest sensors may consist of a single fiber or tens of thousands of fibers, depending on the neutron flux to be detected. An important advantage is that high-speed electronics can be utilized to give detectors an improved dynamic range—something not feasible with gas tubes.



Major nuclear, electronic, and optical processes detect a neutron with a scintillating fiber waveguide.

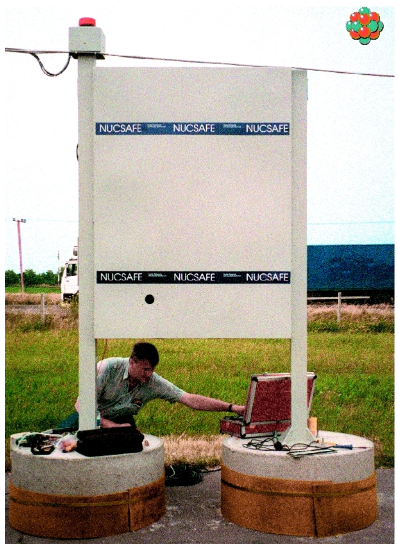
Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Fiber optic sensor technology is a novel application for glass scintillators. Ionizing radiation interacts with the scintillating fibers and produces light. This light is trapped in the fiber and travels down its length. At the ends of the fiber, the light is converted to an electrical signal using photomultiplier tubes. The signal is interpreted as either a neutron or gamma-ray interaction based on its size and the statistical confidence required for the conditions. Neutrons produce larger signals than gamma-rays. The threshold for the minimum signal size to be classified as a neutron event is based on statistical confidence limits to assure neutrons are not mistaken for unusually bright gamma-ray events.

PUMA, a fiber optic neutron and gamma ray sensor, is a solid-state thermal neutron detector.

Features:

- light weight and cost-effective
- stationary or portable
- no high-pressure or toxic gases
- automated to detect special nuclear materials



PUMA received two major awards for scientific achievement. The Federal Laboratory Consortium awards "excellence in technology transfer" while R&D Magazine annually honors the top technologies. PUMA garnered both the FLC and R&D 100 awards in 1999.

Where greater flexibility leads

Teams of Pacific Northwest scientists—materials, nuclear, optical, and electronic—have contributed to the development of fiber optic sensors for radiation detection. Potential future applications include therapeutic treatment for brain tumors, property protection, portal monitoring, and large area searches.

Pacific Northwest actively seeks partners and clients with novel applications that might benefit from the use of fiber optic sensors.

For further information contact:

Mary Bliss
Pacific Northwest
National Laboratory
P.O. Box 999, P8-20
Richland, WA 99352
Telephone: (509) 376-5578
Facsimile: (509) 376-3868
E-mail: mary.bliss@pnl.gov

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